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ABSTRACT

The paper examines applications of computers in deaf education, noting three major functional areas: (1) the computer as a tutor; (2) the computer as a tool; and (3) the computer as a tutee. Software in the tutor mode (computer assisted instruction) is reviewed, and the need for software in the language arts area is noted. Computer applications that bridge the tutor and tutee modes (including authoring systems and programing languages) are also noted. Computer tools include word processing and database programs, which may be incorporated into science or social studies curricula. The special appropriateness of LOGO for hearing impaired children is also described. Microcomputers should be viewed as technological instruments that expand a student's intellectual environment. (CL)

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Computer Applications In Deaf Education

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More powerful than an electronic workbook, the microcomputer has many important applications in the field of education of the deaf. These include computer assisted instruction, word processing, data base programs, spreadsheets, authoring systems and programming languages such as Basic and Logo. Taylor (1980) suggests a method for understanding and organizing the application of computers in education. He divides educational computer usage into three modes. In the first mode, the computer is utilized as a "tutor." To function as a tutor in a particular subject, the computer must be programmed by experts in programming and in that subject. According to Taylor (1980, p. 3) "the student is then tutored by the computer executing the program or programs. The computer presents some subject material, the student responds, the computer evaluates the response, and from the results of the evaluation, determines what to present next. At its best, the computer tutor keeps complete records on each student being tutored; it has at its disposal a wide range of subject detail it can present; and it has an extensive and flexible way to test and then lead the student through the material. With appropriately well-designed software, the computer tutor can easily and swiftly tailor its presentation to accommodate a wide range of student differences." The tutor mode is often referred to as CAI -- Computer Assisted Instruction. Its base may be a mainframe computer with many student terminals, or software booted on a microcomputer. According to Suppes (1980), the tutor mode can provide drill and practice, introduce new concepts and offer a dialogue or interactive program with students.

In the second mode, the computer is utilized as a "tool." To function as a tool, a particularly useful capability must be program-

med into the classroom computer. (Taylor, 1980) A computer that has been programmed as a word processor may be used by the student as a tool. A computer that has been programmed to organize and retrieve materials, as is the case with a data base, may also be used by the student as a tool. The same is true with the computer as a calculator or spreadsheet.

In the third educational application, the computer functions as a "tutee." According to Taylor (1980, p. 4) to "use the computer as a 'tutee' is to tutor the computer; for that, the student or teacher doing the tutoring must learn to program, to talk to the computer in a language it understands. The benefits are several. First, because you can't teach what you don't understand, the human tutor will learn what he or she is trying to teach the computer. Second, by trying to realize broad teaching goals through software constructed from the narrow capabilities of computer logic, the human tutor of the computer will learn something both about how computers work and how his or her own thinking works. Third, because no expensive predesigned tutor software is necessary, no time is lost searching for such software and no money spent acquiring it." Luehrmann (1980, p. 133) states that "computing constitutes a new and fundamental intellectual resource." Luehrmann perceives as wasteful the use of this powerful resource as a mere delivery system for instruction, as in the case of CAI. He suggests that a student receive instruction in how he might use the resource himself. "What a loss of opportunity if the skill of computing were to be harnessed for the purpose of turning out masses of students who were unable to use computing!" (Luehrmann, 1980, p. 134).

How do these three modes of computer usage apply to the educa-

tional of deaf children? The use of the tutor mode -- or CAI -- with hearing impaired students is well documented in the literature. Rose and Waldron (1984) report the findings of a national survey of microcomputer use in programs for hearing-impaired children. Of the 342 programs surveyed, 82% responded, and 51% used microcomputers as an instructional aid. The survey found a total of 979 microcomputers being used in 115 programs serving hearing-impaired students. There was an average of 8 microcomputers per school. According to Rose and Waldron, drill and practice -- a typical example of computer assisted instruction -- was the primary use of the microcomputer by 80 of the 115 users. Tutorial usage -- described as the presentation of materials and questions to students -- was also a popular application. In the area of math computational skills, there is a wide variety of software that is appropriate for use with hearing-impaired students. Most software will keep track of students' scores and many have diagnostic tests that automatically place students at appropriate levels. In this subject area, it is also easy to integrate computer activities with classroom curriculum. Concept based programs -- such as "Juggle's Rainbow," "Gertrude's Secrets," and "Rocky's Boots" -- all from The Learning Company -- are wonderful ways to allow all children to discover opposites, attributes and Logic. It is difficult though to find appropriate CAI materials in the areas of reading and language for hearing impaired students. The need for appropriate instructional software for use with hearing-impaired students in the language areas was also noted by Rose and Waldron. Although there is some commercially available software developed specifically for hearing impaired students in the area of language arts -- Dormac's syntax program being one example -- most language arts material is inappropriate. The

vocabulary is often unfamiliar to the prelingually deaf and must be pretaught before the software can be used. If a teacher is using a particular reading text, and other written language and spelling materials with her students, the addition of the vocabulary of unrelated computer software can be overwhelming for the student. Of course a teacher could select particular software and use it as the primary source of instruction.

Although properly classified in the "tutee" mode, programming languages can be used by teachers to create their own individualized CAI type software. A creative teacher can use the Basic and Logo programming languages to write programs that help children create poetry, use prepositions appropriately, develop sequencing skills, improve reading and enhance many other language related abilities. With a fundamental knowledge of these two programming languages, teachers can alter programs found in the computer literature to meet the specific needs of the deaf youngsters in their classes.

Another educational computer application that bridges the tutor and tutee modes is the authoring system. An authoring system allows classroom teachers to create CAI-type software to meet the particular needs of his or her students. Authoring systems have always been popular with teachers of the hearing impaired. Fleming (1983) discusses use of the Blocks Authoring System at the California School for the Deaf. According to Fleming, the Blocks system enables teachers without any programming experience to create and illustrate lessons that run on the computer. These lessons can be for any subject at any grade level. Although the Blocks system seems valuable, Pollard and

Shaw (1982) have found the actual process of transferring Blocks lessons from paper to disk to be quite time consuming and suggest the use of aides and volunteers to help with construction of lessons. Teachers at the Nassau BOCES Program for the Hearing Impaired have found EZ Pilot, an authoring language developed by Earl Keyser, to be an effective authoring system for use with hearing impaired students. Teachers may create lessons that reinforce exactly what is being taught in the classroom. Truly easy to learn, I have used EZ Pilot to develop individualized reading, spelling and math applications software for may students. EZ Pilot may be used with the Koala Pad touch tablet -- allowing teachers and/or students to draw accompanying graphics freehand as they would with a ditto. When an authoring system is as easy to use as a ditto, teachers will really use it.

Fleming (1983), Moore (1983) and Smaldino et. al. (1983), all refer to the use of the tutor -- or CAI -- mode of microcomputer usage. These educators appear to have overlooked the function of the computer as a tool with hearing impaired students. How can the tool mode of computer usage be adapted to the hearing impaired student? When programmed as a word processor, the computer is a wonderful and powerful learning tool for hearing impaired students. Unlike programming languages -- which we will discuss later within the tutee mode -- use of the word processor requires a minimum of teacher training. (The tutor -- or CAI -- mode requires virtually no computer expertise on the part of the teacher -- beyond knowing how to insert software and turn on the computer.) The application of word processing to the development of the written language skills of deaf children is only limited by a teacher's imagination. It is a powerful motivation tool.

Word processing is also a lifelong marketable skill. Language development and word processing can go hand in hand. Rather than using "dittos" for teacher-made language exercises, a teacher may type these exercises using a word processor and save them to a disk. The disk may be loaded in class; each student go through the exercises and print out a copy. Errors may be discussed, and then corrected on the computer. Perfect copies may then be printed. Some activities easily adapted to the word processor are sequencing skills, grammatical exercises, spelling, vocabulary development, alphabetizing and most importantly -- creative writing. Together with a graphics tool -- such as a Koala Pad touch tablet or Printers Workshop -- students can use the word processor to write a class newspaper or create story books for younger students. Social studies and science reports may be written on the word processor. Most importantly, computer activities can truly be integrated with the rest of your curriculum. You can easily use science vocabulary, review spelling words and practice specific syntactic structures. A spelling check program is available with most word processing programs if desired by the teacher. A teacher will also find a word processor invaluable for her/his own paper work. The word processor will one day make the typewriter obsolete. Incidentally, I prepare my plan book weekly on the word processor.

A data base program is also a wonderful computer tool that can be used in the education of deaf children. Caron (1984) and Hunter (1984) both suggest use of a data base program as part of a science or social studies curriculum. PFS File is a data base program easily used by students -- hearing or hearing impaired -- to help with research projects. The PFS data base allows you to create "fields" or "categor-

ies" that will accept information. If the form you create relates to countries, some of the fields might be "name of country," "capital city," "goods produced," etc. The program then allows you to perform certain functions upon this information. For example, you may search and find all of the countries that produce wheat. Such a program can be used to develop tailor-made research tools for hearing impaired children at their particular language and conceptual level. Of course, a teacher may use a data base system to keep class records or lesson plans. As an educational tool, the data base allows the computer to become an integral part of the curriculum. The student also has the added bonus of learning to use a data base -- an important tool in the business world.

Another tool application of the microcomputer in education is the spreadsheet. It can be used in high school math class to illustrate how business predictions can be made. What if a company sells 100 more cars next year than this year? A spreadsheet can instantly give you the profit expected should this occur. Spreadsheets are commonly used in the business world, and hearing impaired students should have an opportunity to become familiar with them while still in school. A spreadsheet can also be used by the teacher to keep records of student grades. Grades may be instantly averaged for a series of tests.

When a student -- hearing-impaired or not -- learns to speak the language of the computer, he or she is functioning within the "tutee" mode. The student is actually teaching the computer. The computer becomes an intellectual environment for the student (Luehrmann, 1980). How can the tutee mode be applied to the education of hearing-impaired children? Hearing-impaired students can learn to

write computer programs, thereby growing intellectually. In addition, Moore (1983) recognizes computer programming as an excellent occupation for hearing-impaired people. Deaf students may learn to write programs in Logo, Basic or other programming languages.

What is Logo? Logo is a computer language that was developed by Seymour Papert at M.I.T. It uses simple commands that allow the child to easily draw pictures on the computer screen. The child may draw pictures in the immediate mode and see his or her work "immediately," or the child may use the edit mode to write and save programs that will draw pictures for him or her when these programs are called by their names. The graphics cursor, which is triangular in shape, is called a "turtle" -- hence the name "turtle graphics."

Why is Log appropriate for hearing impaired children? Hearing impaired children, particularly the prelingually deaf, have great difficulty acquiring language. In fact, the development of speech and language is the most important aspect of the hearing impaired child's education. Although a week area for deaf children, language must often be used to convey concepts in other curriculum areas. Logo can encourage language growth, and developing procedures and solving problems with Logo does not require a level of linguistic competence which a deaf or hearing impaired child might not have. Logo can provide an opportunity to use a child's firm knowledge of space and his or her body to explore math (turtle geometry) and physics (Papert, 1980). The child need not be able to comprehend or produce complex syntactic structures in order to use Logo commands and develop procedures. Through the use of these commands and procedures, he can have numerous

opportunities for language development. In my classroom, I have found Logo to be an exciting way to help hearing-impaired children acquire concepts of directionality and sequencing, explore geometry, learn to follow and give spoken and written decisions, improve language ability, develop different approaches to problem solving and learn to work together.

Several articles concerning the use of Logo with hearing impaired children can be found in the literature. Grand and Semmes (1983) used Logo with five year old twins, one profoundly deaf and the other with normal hearing. They presumed that Logo could "promote both proficient language (e.g., vocabulary, syntax, and recursive property) (p. 565)" could help young children develop linguistic awareness. Grant and Semmes recognize a relationship between Logo's process of making a square and the language principle of conjoining. "The finished square is composed of four equal commands, just as a compound sentence, subject or predicate is composed of as many equal components as desired." (Grant and Semmes, 1983, p. 569.) These authors saw a great deal of verbal interaction between their students during eight half hour sessions. The growth and enjoyment experienced by the children convinced the authors that the use of Logo with preschool children, both hearing and hearing impaired, is appropriate (Grant and Semmes, 1983).

Patrick Stone (1983) of the Tucker-Maxon Oral School used Logo with a group of 14 profoundly hearing impaired children, ages 8-14. Stone states that his students developed skills in problem definition, programming, editing, and debugging through the use of Logo. In addition to becoming computer programmers in the true sense by controlling

the computer rather than being controlled by it, Stone's students' experiences with Logo fostered "peer interaction and provided opportunities for aesthetic expression." (Stone, 1983, p. 648)

What other computer languages can hearing impaired students learn to speak? Basic is a common computer language taught in most schools -- for hearing as well as hearing impaired students. In their study, Rose and Waldron (1984) found that approximately 85% of hearing impaired schools using computers had the Basic language available. Incidentally, Logo and Pilot languages were found in only 10% of the schools. The authoring language EZ Pilot is a good first computer language for students to learn. Seventh graders, for example, might use the EZ Pilot language to write CAI software for third or fourth graders. According to Papert (1980), the best way to learn something is to teach it. By constructing a reading lesson, older students will learn a great deal about the material they are using -- including syntax, vocabulary and spelling.

Summary

In conclusion, the microcomputer can have three different modes -- or functions -- in the education of hearing impaired students. The microcomputer can be a tutor, tool or tutee. (Taylor, 1980) CAI may be best for computation; the word processor for developing language; Logo for problem solving; the data base for research; and so on. The tutor and tool modes require a minimum of teacher training, as does the EZ Pilot authoring language. Computer activities can become an integral part of the hearing impaired curriculum. Use of the microcomputer in the classroom should not be thought of as a separate educational

activity, but rather a technological instrument that expands a student's intellectual environment.

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